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Dry-Fermented Sausages and Ripened Meats: An Overview

Fidel Toldrá¹ and Y.H. Hui²

¹*Instituto de Agroquímica y Tecnología de Alimentos (CSIC), Paterna, Valencia, Spain*

²*Science Technology System, West Sacramento, CA, USA*

1.1 Introduction

Drying and smoking were probably the first food-preservation techniques to be developed, in ancient Greece and Rome (Zeuthen, 2007). In fact, the names “sausage” and “salami” probably originate from the Latin words “*salsiccia*” and “*salumen*,” respectively (Toldrá, 2012). Historically, the manufacturing procedures used to make fermented sausages were adapted to the climatic conditions of the production area. For instance, Mediterranean meat products are dried to low water activity (a_w) values, taking advantage of the long dry and sunny days, while in Northern Europe fermented sausages require smoking for further preservation (Toldrá, 2006, 2014a). Summer sausage is traditionally produced in the summer and is heated for safety reasons (Zeuthen, 1995).

Preservation results from a series of specific factors known as “hurdle effects” (Leistner, 1992):

- addition of nitrite, salt, and/or sugar;
- reduction of redox potential;
- introduction of lactic acid bacteria (LAB);
- lowering of pH;
- decreasing of a_w ;
- smoking.

The sausage remains stable throughout this sequence of hurdles (Leistner, 1995).

LAB play important roles in safety, nutrition, and sensory quality (Toldrá *et al.*, 2001), and develop important reactions essential to the development of adequate color, texture, and flavor (Demeyer & Toldrá, 2004). Details can be found in Parts II and III of this book.

This chapter lists some of the most important fermented sausages produced worldwide. Further details of sausages and ripened meat products from North America, the Mediterranean, and Northern Europe and Asia can be found in Parts VI, VII, VIII, and IX. Space limitation prohibits an in-depth discussion of fermented sausages from other parts of the world; the interested reader can refer to the references for further information.

1.2 Fermented sausages and ripened meats around the world

1.2.1 North America

Manufacturing practices were brought to North America by the first European settlers. Today, many European fermented sausages can be found in northern states such as Wisconsin (Toldrá & Reig, 2007). Lebanon bologna is a semidry-fermented sausage originating from Lebanon County, Pennsylvania. It is produced from beef and black pepper, fermented to a very high pH, and heavily smoked (Rust, 2004). Pepperoni is produced from pork and/or beef and seasoned with red pepper, ground cayenne pepper, pimento, aniseed, and garlic. It has a small diameter and is smoked.

1.2.2 South and Central America

There is a general Spanish and Italian influence on fermented meat products in many Latin America countries. Italian milano and cacciatori are consumed in Uruguay, Brazil, and Mexico, among other places. In the Andes, traditional fermented sausages are made from llama meat and guanaco.

1.2.3 The Mediterranean

Many types of dry-fermented sausage are produced in the Mediterranean area. They are usually dried, due to the climate, and are rarely smoked. They have a variety of diameters, shapes, sizes, spices, seasonings, and sensory characteristics. Their names differ according to the geographic origin, sometimes even between very close areas (Toldrá, 2006). Pork is the main meat, and fungi starters may be used for development on the external surface (Talon *et al.*, 2004). Salamis of medium diameter (around 6 cm) include French menage, French saucisson d'Alsace, Italian turista, and Spanish salchichón, while those of larger diameter include French varzi, Italian milano, and Italian crespone; the latter may be ripened for more than 60 days (Toldrá & Flores, 2014). Coppa is an Italian salami with cylindrical shape. It is made from pork shoulder butt salted for 7–10 days

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and dried for 2–4 weeks. Spanish chorizo, which has a strong red color, is seasoned with garlic, pepper, and oregano (Toldrá, 2002). Mortadella bologna is produced from pork meat and fat, and the final sausage is thermally treated to an internal temperature of 68 °C (Toldrá, 2014a).

Dry-cured ham is extensively consumed in Mediterranean countries. It is a dry-cured whole-meat product produced by curing, salting, drying, and ripening for as long as 24, or sometimes even 36, months (Toldrá, 2014b). It receives different names according to the region, such as serrano or ibérico in Spain, prosciutto di Parma or San Danielle in Italy, Bayonne in France, and Ardennes in Belgium (Toldrá, 2014a).

1.2.4 Northern Europe

A good number of fermented meats are produced in Northern Europe. The greußner salami is produced in Thuringia, Germany. It is a sliceable sausage produced from beef and some pork, as well as fat, and flavored with garlic, pepper, and other spices. It undergoes a long-term fermentation process and cold smoking. The rügenwalder teewurst is a semidry-fermented sausage, also produced from beef and pork, which is fermented and cold-smoked (Gibis & Fischer, 2004). The Austrian katwurst is a long, dried sausage. The Swedish metwurst contains some potato, in addition to spices and seasonings. Other meats can be added to the formulation of sausages in Scandinavian countries, such as horse meat in farepols, toppen, trøndermør, stabbur, and sognekørr in Norway and kotimainen meetwurst in Finland; lamb meat in lambaspæipylsa in Iceland; and reindeer meat in poro meetwurst in Finland and rällersnabb gilde in Norway (Campbell-Platt, 1995).

Several fermented sausages are produced in Poland, mainly from pork, but also beef, game, and poultry (Pisula, 2004). Krakowska sucha is produced from pork and beef, plus black pepper, nutmeg, and garlic. It is dry-cured, smoked, cooked, and dried for about 3 weeks. Kabanosy is produced from pork and black pepper, nutmeg, and caraway. It is smoked and dried for 3–5 days. Jalowcowa is produced from pork and a little beef, plus pepper and juniper. It is dry-cured, smoked, cooked, and dried for 3–5 days (Pisula, 2004).

1.2.5 Eastern Europe

The Hungarian salami is a good example of a typical salami. It is intensively smoked and then its surface is inoculated with mold starters or spontaneous mold growth (Incze, 2004). It is seasoned with white pepper, garlic, red wine, and paprika. Similar sausages include winter salami, also produced in Hungary, and hermannstädler, produced in Romania (Roca & Incze, 1990). Russian salami and Moscow salami are produced in Russia from pork, and sometimes some beef.

1.2.6 The Middle East

Fermented sausages are produced from many different animals (beef, buffalo, mutton, lamb, goat, camel, and horse) in Middle Eastern countries. Pork meat is not used, because of religious prohibition. Sausages, which can contain rice, wheat, corn, and rice flour, are cured and smoked. Different flavors are imparted by the addition of olive oil, garlic, cinnamon, onion, paprika, black pepper, rosemary, and so on. Fermented and strongly smoked beef sausages were first produced in Lebanon and then spread to other countries (El-Magoli

& Abd-Allah, 2004). Soudjouk sausages, using only beef, buffalo, and/or mutton and fat-tailed sheep, are produced in Turkey (Gökalp & Ockerman, 1985). They may be heavily seasoned by garlic, red and black pepper, cumin, pimento, and olive oil.

Pastırma is extensively consumed in Turkey and North African countries. It is a dry-cured whole-meat product produced by curing, pressing, and drying. Up to 21 different types can be found, depending on what part of the animal (usually water buffalo or beef) is used (Yalinkılıç *et al.*, 2014). It is usually covered with a layer prepared from water, garlic, red pepper, paprika, and flour from the seed of *Trigonella foenum-graecum* (Ceylan & Aksu, 2011). Pastırma production typically occurs in October/November, a period called “*pastırma yazı*” (“summer of pastırma”).

1.2.7 Africa

Biltong is a typical South African meat product. It is produced from young and lean carcasses of either cattle or game, especially from the round, loin, and tenderloin. The meat is ripened and dried until losses exceed 50%. Salt, sugar, pepper, and roasted ground are added. Vinegar and saltpeter can also be used (Strydom, 2004).

Other typical fermented and sun-dried products are summarized by Campbell-Platt (1995). Most are produced in north-eastern Africa. Miriss and mussran are made from the fat surrounding a lamb's stomach and small intestine, respectively. Similar products include twini-digla and um-tibay. Beirta is made in Sudan from goat meat and offal, kaidu-digla is made from chopped bones, and dodery, mulaa el-sebit, and aki-el-muluk are made from crushed bones, marrow, and fat.

1.2.8 East Asia

Most of the information in this chapter on fermented sausages from East Asian countries is derived from recipe books in both Chinese and English. The English references include: Aidells & Bruce (2000), Campbell-Platt (1995), Inglis *et al.* (1998), Leistner (1995), Rogers (2003), Solomon (2002), and Trang (2006). Although their descriptions here do not detail the fermentation stage, most East Asian sausages require short or long-term fermentation during the manufacturing processes.

India, Indonesia, Japan, Malaysia, and various other countries do not have specialty fermented sausages, although ethnic groups within these countries have their own ethnic heritage sausages, such as the Chinese, the Thais, and so on. European-style sausages are now produced in Japan and India.

1.2.8.1 Chinese sausages

“Lap cheong” (la chang) is a general term for Chinese sausages, but it can also be used to describe Chinese pork sausages. Literally, it means winter (*lap*) intestines (*cheong*), which can be interpreted as “intestines stuffed in the winter.” Traditionally lap cheong is made in the winter months to take advantage of the lower temperatures, which reduce the chance of spoilage during curing after the sausages are stuffed. The ingredients vary from place to place, but essentially they are cut-up pork and pork fat (today ground pork and fat), sugar, and salt, plus optional ingredients such as soy sauce, alcoholic beverages, spices, and others. The amount of pork fat used also varies, with regular and low-fat types of lap cheong more common nowadays. Traditionally, when the intestines or casings are stuffed

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at the beginning of the winter season, they are hung by a string in a ventilated area to gradually dry the ingredients and the surface, and to produce the typical flavor (odor, color, and texture). With the decrease in a_w and moisture content, the product hardens and can be kept edible (after cooking) for the winter and spring months. It is not uncommon to see mold and yeast development on the surface of the dried product when the relative humidity is high. In order to extend the self-life, some people store a small amount of the dried product in oil in a sealed container in a cool place. This can keep the product available for the summer and even the autumn months. For several decades, industrial production of lap cheong has involved curing or drying of the green sausage in temperature- and humidity-controlled dryers, in order to speed up the process. The product is now packed in vacuum-sealed pouches and it is recommended these be stored in refrigerators in order to maintain quality year-round. However, the traditional procedure is still practiced in rural areas of China.

Aap gon cheong

Aap (duck) gon (liver) cheong (sausage) is a specialty Cantonese product made in a similar manner to lap cheong, but with cut-up duck liver replacing the pork. The amount produced is small due to the low availability of duck liver. Traditionally, soy sauce is one of the main ingredients in the making of duck-liver sausage, and it contributes to the special flavor.

Gam ngan cheong

Gam (gold) ngan (silver) cheong (sausage) is a very special Cantonese product that is made without a casing. A chunk of pork fat is cut into a wedge shape and wrapped with thin slices of pork liver that have been marinated with salt and sugar. The gam ngan cheong is then dried naturally in the same way lap cheong is cured. Because of concerns over cholesterol and fat intakes, this product has become less popular recently.

Chicken-liver sausage, with or without pig liver

This is a modification of aap gon cheong, with chicken and/or pig liver replacing the duck liver.

1.2.8.2 Singaporean sausages

Singaporean sausages are similar to Chinese sausages. This is understandable as the majority of the population in Singapore is of Chinese ethnic origin. They include special-grade (reduced-fat) pork sausage, chicken sausage, and pig-liver sausage.

1.2.8.3 Thai sausages

Sai ua (a dried northern Thai sausage)

Sai ua is made by stuffing pork with Thai curry paste (onion, galangal, lemon grass, parsley's root, curcuma, chili, and salt mashed in shrimp paste) into a pork casing. It is dried and roasted before consumption.

North-eastern sour Thai-style sausage

North-eastern sour Thai sausage is made with ground pork, cooked rice, nitrite, erythorbate, pepper, salt, and sugar. After the mixture is stuffed into a pork casing, it is kept at room temperature for about 24 hours to allow lactic acid fermentation. The sour sausage requires thorough cooking (such as roasting or frying) before consumption.

Nham (Thai fermented sausage)

Nham is made similarly to north-eastern Thai sour sausage, except that chili and pork skin are also added, and the mixture is packed in bamboo leaf or plastic film. After keeping (fermenting) for 3–4 days at room temperature, the sausage is ready for cooking and consumption. Currently, some manufacturers apply irradiation treatment to kill parasites and ensure safety.

Goon Chiang

Goon chiang is made by first marinating the pork with nitrite at refrigerating temperature for 24 hours, and then grinding and mixing it with sugar and erythorbate and stuffing it into pork casing. It is dried at 60 °C to appropriate dryness. This sausage requires cooking before consumption.

1.2.8.4 Filipino sausage

Longamisa

Longamisa is a sweet–sour sausage made rurally using lean pork, pork fat, white vinegar, soy sauce, and sugar. After stuffing, it can be smoked or cooked fresh.

1.2.8.5 Korean sausages

Sundae

This Korean stuffed sausage is popularly sold by street vendors. It is made with pig's blood, rice, green onions, garlic, minced pork, and sweet-potato vermicelli, all stuffed into small and large pig's intestines. It is steamed before consumption.

Soonday

Soonday is also popularly sold at public markets. The stuffing consists of firmly cooked rice, crushed garlic and cloves, crushed fresh ginger, black or white pepper, Korean sesame oil, crushed sesame seeds, crushed scallions, and either beef or pork blood. The mixture is stuffed into small beef intestines. The sausages are cooked in water before consumption.

1.2.8.6 Nepalese sausages

Nepalese sausage is similar to German sausage except that chicken is used as the main meat ingredient.

1.2.8.7 Sri Lankan sausages

Sri Lankan sausage is made with lean pork, pork fat, toasted and ground coriander seeds, ground cinnamon, ground cloves, ground black pepper, finely grated nutmeg, salt, and vinegar. After stuffing, it is cold smoked at temperature not higher than 30 °C for a few hours, to appropriate dryness. It requires proper cooking before consumption.

1.2.9 The Pacific Rim

Pepperoni is produced in Australia. Vento salami, made from beef with peppercorns and red wine, is also produced there (Campbell-Platt, 1995).

1.3 The importance of fermented sausages

Fermented sausages are very popular with most population groups that consume meat. Science and technology have played

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an important role in improving the quality and storage time of fermented sausages, especially in Europe and Central, South, and North America. However, the development and production processes in countries such as China are still more art than science.

Most of us like fermented sausages, and this type of processed meat product has been and will continue to be significant in our diets.

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